

**PRELIMINARY  
HYDROGEOLOGIC INVESTIGATION  
OF PERCHLORATE IN GROUND WATER  
at the Former PEPCON Plant  
Henderson, Nevada**

Prepared for:

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January 23, 1998

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Dear Mr. Gibson:

Please find attached the report entitled *Preliminary Hydrogeologic Investigation of Perchlorate in Ground Water at the Former PEPCON Plant, Henderson, Nevada*. This report includes a description of the activities performed, summary of available data, results of exploration and ground-water analyses, and recommendations for additional investigation. This investigation was conducted in accordance to our work plan dated November 3, 1997 with some exceptions which are explained in the text.

If you have any questions regarding the work performed or results obtained, please do not hesitate to contact us.

Sincerely,

BROADBENT & ASSOCIATES, INC.



Robert C. Broadbent, EM-1008 (exp. 11/12/98)  
Principal Hydrogeologist

*JURAT: I, Robert C. Broadbent, hereby certify that I am responsible for the services described in this document and for the preparation of this document. The services described in this document have been provided in a manner consistent with the current standards of the profession and to the best of my knowledge comply with all applicable federal, state and local statutes, regulations and ordinances.*

enclosure: *Preliminary Hydrogeologic Investigation of Perchlorate in Ground Water,  
Former PEPCON Plant, Henderson, Nevada*

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## **1.0 INTRODUCTION**

This report presents results from a hydrogeologic investigation of perchlorate in ground water at and near the former Pacific Engineering & Production Company of Nevada (PEPCON) plant in Henderson, Nevada. This investigation was conducted in accordance to our work plan submitted to the Nevada Division of Environmental Protection (NDEP) dated November 3, 1997, with some exceptions which are explained in the relevant sections of this report.

### **1.1 Manufacturing Site Location and History**

The former PEPCON plant was engaged in the production of chemicals that included oxidizers used as components in solid rocket motors. One of the chemicals produced for this purpose was ammonium perchlorate. The plant began the production of ammonium perchlorate in 1958 and operated until May 4, 1988 when the plant was destroyed by an explosion.

### **1.2 History of Perchlorate Issue in Nevada**

In April 1997, a chemical analysis technique was developed which quantified perchlorate in water at concentrations as low as 0.004 milligrams per liter (mg/l). Perchlorate is not a regulated compound under the Safe Drinking Water Act or in the State of Nevada. California has instituted a perchlorate interim action level of 0.018 mg/l. The Metropolitan Water District detected perchlorate in Colorado River samples in July, 1997. The Southern Nevada Water Authority began collecting water samples from Lake Mead in July, 1997 and detected low concentrations of perchlorate. The NDEP collected water samples from Las Vegas Wash during the week of August 10, 1997 and detected perchlorate concentrations of between 1 mg/l and 2 mg/l. During the week of August 24, 1997 the NDEP and Kerr McGee Chemical Corporation (KMCC) collected ground-water samples in the vicinity of the KMCC plant and detected perchlorate concentrations as high as 18,000 mg/l. Perchlorate products have been produced at the KMCC plant from 1945 to the present. Perchlorate containing wastes were discharged to the environment at the KMCC plant site, the Basin Management Incorporated (BMI) landfill, the Beta Ditch and the Upper BMI ponds (Kleinfelder, 1993).

On August 19, 1997, the NDEP requested that PEPCON submit a work plan to sample ground water in the vicinity of the former plant location. In response to this

request, Geotechnical & Environmental Services, Inc. (GES) drilled and constructed six monitoring wells between August 28, 1997 and September 6, 1997. Ground-water samples were collected from these six wells and two pre-existing monitoring wells on September 11, 1997 and September 15, 1997. Laboratory analyses indicated that perchlorate was present in these wells at concentrations varying from below the detection limit to 631 mg/l. The results of this investigation were presented in the September 30, 1997 GES report *Former PEPCON Plant Preliminary Evaluation of Groundwater Perchlorate Concentrations, Henderson, Nevada*. A copy of the report is included as Appendix A. Based on these results the NDEP requested that PEPCON and KMCC develop work plans to delineate the extent of perchlorate impacted ground water. Broadbent & Associates, Inc. (BAI) developed a work plan on behalf of PEPCON, which was submitted to NDEP on November 3, 1997.

BAI and GES then began an investigation to evaluate perchlorate concentrations in ground water, hydrogeologic conditions that influence the subsurface flow, and the distribution of perchlorate in ground water. Since November 3, 1997 eleven additional monitoring wells have been drilled, constructed, surveyed and sampled. In addition water samples have been collected from 35 existing monitoring wells and several locations on Las Vegas Wash. Available reports and data relevant to this investigation have been reviewed and interpreted. This preliminary report was prepared summarizing the results of the investigation to date and to provide a plan for the continuation of the investigation. A final report summarizing this investigation will be submitted on May 1, 1998.

## **2.0 SCOPE OF WORK**

The following tasks were performed during the investigation:

- o Review and interpretation of existing data and reports related to the geology and hydrogeology of the area in the vicinity of the former PEPCON site where perchlorate has been detected in ground water;
- o Installation, construction, and sampling of eleven monitoring wells;
- o Execution of field search locating existing wells in the project area;
- o Collection of water samples from existing wells and analysis for perchlorate;
- o Collection of surface water samples from the Las Vegas Wash and springs near Las Vegas wash;
- o Preparation and submittal of this preliminary data summary report.

### **3.0 RESULTS OF INVESTIGATION**

#### **3.1 Field Investigation**

##### **3.1.1 Field Search of Existing Wells and Water Sampling**

Individuals on behalf of PEPCON and KMCC conducted a field search for existing wells in the Las Vegas Wash Area. Numerous monitoring wells have been drilled in the area by various companies or agencies. The locations of previously drilled wells were estimated from existing reports. Many of the monitoring wells have been destroyed or abandoned over the years.

##### **3.1.2 Ground-Water Monitoring**

Eleven monitoring wells were drilled, constructed and sampled in accordance with the work plan. The wells were designated as MW-G, MW-H, MW-I, MW-J, MW-K, MW-L, MW-N, MW-O, MW-P, MW-Q, and MW-R. Lithologic logs and well construction information are presented in Appendix B. The locations of these wells are indicated in Drawing 1. Ground-water samples were collected from these eleven wells and 41 pre-existing wells and analyzed for perchlorate. The "H" series of wells previously drilled on and around the Pioneer Chlor Alkali Company property were not purged prior to sampling due to purge water disposal issues. These wells have a large diameter and would require purging approximately 200 to 300 gallons per well. In addition, samples were collected by KMCC and NDEP contractor and analyzed for perchlorate. Table 1 summarizes available perchlorate data collected from monitoring wells to date. Drawing 1 indicates monitoring well locations and contours of equal perchlorate concentrations. The data used in Drawing 1 was collected over a six month period.

The locations and measuring point elevations of the monitoring wells were surveyed by a licensed surveyor. Ground-water elevations were measured during sampling events. Table 2 presents depth to ground water and measuring point elevation data for the sampled wells.

##### **3.1.3 Surface-Water Monitoring near Las Vegas Wash**

Surface water samples have been collected by NDEP and BAI. These results are summarized in Table 3. The location of the Las Vegas Wash samples and perchlorate concentrations are shown in Drawing 2. Several samples were collected from seeps and excavations near Las Vegas Wash. Several samples have also been collected from the Las Vegas Wash itself. For the most part, samples collected from Las Vegas Wash upstream of

the location of the Pittman Bypass Outfall had perchlorate concentrations near a background concentration of about 0.010 mg/l. At the wash crossing at Poleline Road the average concentration was 0.60 mg/l. Samples collected at North Shore Road bridge averaged approximately 0.90 mg/l.

Based on these results it appears that most of the perchlorate present in Las Vegas Wash enters the Las Vegas Wash downstream of the Pittman Bypass Outfall. It appears that a significant quantity of perchlorate is entering the Wash from the south bank in the vicinity of the Poleline Road Crossing. Las Vegas Wash flow is carried beneath the Poleline Road in four separate culverts. One culvert is dry. Samples collected from the three remaining culverts and analyzed by American Pacific Laboratories showed an increase in perchlorate concentrations from north to south. The sample collected from the north culvert had a perchlorate concentration of 0.50 mg/l. The sample collected from the middle culvert had a perchlorate concentration of 0.60 mg/l; and the sample collected from the south culvert had a perchlorate concentration of 0.68 mg/l. Duplicate samples analyzed by Weck Laboratories also showed an increase in perchlorate concentration from the north culvert to the south culvert, but the perchlorate concentration detected in the middle culvert was slightly less than that detected in the sample collected from the north culvert. Despite this, perchlorate concentrations were highest in the samples collected from the south culvert in the samples analyzed by both laboratories.

#### **4.0 HYDROLOGY**

Las Vegas is located in an alluvium filled structural basin. Las Vegas Wash is located in the lower portion of the basin, and drains surface water flows to Lake Mead. Prior to development, flow in the Las Vegas Wash did not reach Lake Mead except during large rainfall events. As the Las Vegas area developed, sewage treatment plants discharged an increasing amount of water to Las Vegas Wash. Las Vegas Wash flows to Lake Mead consequently increased. The average 1995 flow in Las Vegas Wash measured below Lake Las Vegas was 127.96 million gallons per day (USGS, 1996). The average sewage treatment plant discharge for 1995 from the Clark County Treatment Plant was 62.39 million gallons per day (CCSD, 1998). The average sewage treatment plant discharge for 1995 from the City of Las Vegas was 45.84 million gallons per day (City of Las Vegas, 1998). Complete records for 1995 were not available for the City of Henderson Treatment Plant, but in 1997 this facility had an average wash discharge of 7.49 million gallons per day (City of Henderson, 1998).

Sewage effluent accounts for approximately 90 percent of the total flow in Las Vegas Wash. Other contributions to flow include perennial flows in washes such as Flamingo Wash and Duck Creek, flows from the storm drain system, and ground-water flow to Las Vegas Wash. The water budget of Las Vegas Wash will be investigated more thoroughly and reported in our final report.

#### 4.1 Regional Hydrogeology

The hydrologic units throughout most of the Las Vegas Valley have been divided into two water bearing zones (aquifers). These aquifers are the deep principal aquifer and the near surface aquifer. The deep principal aquifer zone supplies ground water to utility and private water wells, whereas, in most of the valley, the near surface aquifer is not a source of potable water due to low permeability characteristics of the soil and poor water quality. The generally permeability of the principal aquifer is highest in the north western portion of the valley and decreases to the east and south. Most high capacity public water supply wells are located north of Sahara Avenue and west of the eastern boundary of the water district property on Charleston and Valley View Boulevard.

Ground water associated with the near surface aquifer is commonly found within 50 feet of land surface throughout the Las Vegas Valley. The near surface aquifer ground-water flow direction in the Las Vegas Valley is generally toward Las Vegas Wash.

#### 4.2 Local Hydrogeology

The former PEPCON property is located in the southern portion of Las Vegas Valley approximately one mile north of the McCullough Mountains and approximately 3½ miles south of Las Vegas Wash. The former PEPCON property is underlain by well graded deposits of sand and gravel with a small amount of silt. These deposits are mostly cemented at depths greater than 30 feet below land surface (BLS). These cemented deposits are most likely a coarse grained facies of the Muddy Creek Formation. Ground water beneath the property appears to be artesian, with ground water first encountered at about ninety feet BLS during soil boring installation, but rising to approximately 75 feet BLS after monitoring well installation. The cemented gravel deposits appear to become finer north and northeast of the mountain range.

The fine grained facies of the Muddy Creek Formation is present in most of the area east of US 93/95, north of Lake Mead Boulevard, and south of Las Vegas Wash, but is not present beneath the former PEPCON plant. The fine grain facies consists primarily of silt

and clay mixtures with small amounts of sand and gravel. The fine grained facies of the Muddy Creek Formation is overlain by a veneer of alluvial sand and gravel with lesser amounts of silt and clay. The lower zones of these alluvial sediments are often cemented with calcium carbonate.

In the area where the fine grain facies of the Muddy Creek Formation is present, it is believed to be an important factor affecting ground-water flow. Since the fine grained facies has very low permeability, very little ground-water flow occurs through the formation. The upper surface of the Muddy Creek formation forms a low permeability boundary to ground-water present in the higher permeability alluvial sand and gravel deposits above. The elevation of the upper boundary generally slopes to the north and towards Las Vegas Wash with depressions in the surface which may be former erosional "channels." These "channels" are continuous depressions across the top of the Muddy Creek Formation that were buried over time by sands and gravels. Consequently, ground water generally flows to the north and northeast through the veneer of alluvial sand and gravel towards Las Vegas Wash. The saturated thickness of the alluvial sediments varies from tens of feet in the area of the erosional channels to zero in the vicinity of local high elevation areas of the upper surface of the Muddy Creek. Ground-water flow rates are probably generally higher in the areas with thicker saturated thicknesses of alluvial sand and gravel.

The US Bureau of Reclamation prepared a contour map of the elevation of the top of the fine grained facies of the Muddy Creek Formation (USBR, 1984). The contours drawn by the US Bureau of Reclamation are indicated in Drawing 4. Seventeen wells were drilled and logged as a part of this investigation and better defined the upper surface of the Muddy Creek Formation in the area north and northeast of the former PEPCON property. Drawing 5 is a contour map of the upper boundary of the Muddy Creek Formation with contours adjusted to reflect the new data collected in this investigation.

#### 4.2.1 Permeability of the Alluvial Sand & Gravel

Several aquifer pumping tests have been performed in the alluvial sand & gravel deposits overlying the Muddy Creek Formation. Geraghty & Miller (1980) conducted several short term pumping tests in the "H" series of wells. The "H" wells are located in both the alluvial sand & gravel deposits and the upper portion of the Muddy Creek Formation. Due to the low permeability of the Muddy Creek Formation it is assumed that the water produced in the tests of these wells came from the shallow aquifer. The estimated transmissivity from these tests is summarized below:

<u>Monitoring Well</u>	<u>Flow Rate gallons/minute (gpm)</u>	<u>Transmissivity gallons/day/foot (gpd/ft)</u>
H-18	60	63,360
H-19	5	1,320
H-21	33	14,520
H-14	10	1,637

The highest transmissivity calculated of the wells surveyed occurred in well H-18 which is in the center of the buried "channel" in the top of the Muddy Creek formation. Well H-21 is near the "channel" and well H-19 is out of the channel area. KMCC also conducted several aquifer tests (Smith, 1985). They conducted six slug tests in the alluvial sand and gravel deposits in areas outside of the buried "channel" (wells M-2, M-3, M-4, M-8, M-17) and calculated an average transmissivity of 2,270 gpd/ft. They performed one slug test on well M-27 which was completed in the alluvial sand and gravel deposits in a suspected buried channel area and calculated a transmissivity of 23,786 gpd/ft. A pumping aquifer test was conducted in well M-2 with a calculated transmissivity of 1,764 gpd/ft for alluvial sand and gravel deposits not in a channel area. Five tests were also conducted in wells located in the Muddy Creek Formation (M-9, M-11, M-12, M-13) with an average calculated transmissivity of 67 gpd/ft.

These test results indicate that the Muddy Creek Formation has a very low transmissivity (less than 100 gpd/ft). The highest transmissivity values occurred in the alluvial sand and gravel in the "channel" areas (24,000 to 63,000 gpd/ft). Gravels not in the "channel" area were calculated to have an intermediate transmissivity value (approximately 2,000 gpd/ft).

## 5.0 CONCLUSIONS

Based on existing data it appears that the Las Vegas Wash upstream of the Pittman Bypass Outfall has a background perchlorate concentration of about 0.010 mg/l. Below the Outfall the perchlorate concentrations increase to approximately 0.60 mg/l at the Poleline Road wash crossing, and to approximately 0.90 mg/l at the North Shore Road wash crossing. It appears that the source of this perchlorate is the discharge of perchlorate containing ground water to the Las Vegas Wash. Based on preliminary ground-water and Las Vegas Wash samples it appears that most of the perchlorate containing ground water enters the Wash from its south bank along the 1.5 mile reach of the Wash extending downstream from the Pittman Bypass Outfall.

Based on data from monitoring wells it appears that there are two separate perchlorate plumes in the Henderson area of Las Vegas Wash (Drawing 2). The separation of these plumes is established by very low to below detection limit perchlorate concentrations reported for wells H-13, H-15, H-20, H-12, MW-J, MW-R, PL-645, PL-641, and PL-637. Based on the low perchlorate concentrations reported for samples collected from wells HMW-15, HMW-16, and LG-027, it does not appear that the perchlorate plume that intersects the location of the former PEPCON plant reaches the Las Vegas Wash. Additional wells will be drilled in the vicinity of wells HMW-15, HMW-16, and LG-027 to verify that perchlorate is not reaching the wash from this area.

Available ground-water monitoring data indicates that the perchlorate plume intersecting the KMCC plant and most likely the upper BMI ponds most likely reaches the Las Vegas Wash along the 1.5 mile reach downstream of the Pittman Bypass Outfall. This is the region where surface water sample perchlorate concentrations show a marked increase. A sample collected from well PL-635, located along the western edge of the large buried "channel" was analyzed as containing a perchlorate concentration of 22.4 mg/l. Samples collected from wells HMW-8, and HMW-9 near Las Vegas Wash, were also analyzed as containing relatively high concentrations of perchlorate (2.87 and 1.4 mg/l, respectively). A significant flow of ground water to Las Vegas Wash is occurring in the area of HMW-8 and HMW-9 due to the subsurface flow of sewage effluent from the Henderson Rapid Infiltration Basins.

## **6.0 RECOMMENDATIONS**

BAI proposes that the following tasks be performed prior to submittal of our final report on May 1, 1998.

We propose that the following existing twelve wells be sampled: HMW-14, HMW-13, PG-225, DM4, DM5, LG-231, LG-232, PG-211, PG-221, PG220, POD-5, and POD-8. In addition we propose that 13 additional monitoring wells be drilled and sampled at the locations shown in Drawing 5.

We propose to collect additional surface water samples from Las Vegas Wash at intervals of approximately 1,000 feet from a point upstream of Lake Las Vegas to the confluence of Duck Creek.

We propose to conduct one monitoring well sampling and water level measurement event in March or April of 1998. We will try to conduct this monitoring event in coordination with KMCC and to do all sampling and water level measurements over a two week period.

We propose to obtain additional records on Las Vegas Wash Flows and Las Vegas Wash Sewage Plant discharges to further evaluate the water balance of Las Vegas Wash. Ground-water and perchlorate flux rates will be estimated based on available permeability data, aquifer dimension data and measured ground-water gradients.

## **7.0 REFERENCES**

City of Henderson, 1998, Sewage Treatment Plant Discharge Records

City of Las Vegas, 1998, Sewage Treatment Plant Discharge Records

Clark County Sanitation District, 1998, Sewage Treatment Plant Discharge Records

Geraghty & Miller, Inc., October, 1980, Ground-Water Investigation Stauffer Chemical Company, Henderson, Nevada

Geotechnical Environmental Services, 1997, Former PEPCON Plant Preliminary Evaluation of Groundwater Perchlorate Concentrations, Henderson, Nevada.

Kleinfelder, Inc., April, 1993, Environmental Conditions Assessment, Kerr-McGee Chemical Corporation, Henderson, Nevada

Kerr-McGee Chemical Corporation, July, 1985, Geohydrological Investigation, Kerr-McGee Chemical Corporation (Report prepared by Bert J. Smith).

Nevada Division of Environmental Protection, January, 1998, Perchlorate Concentrations and Specific Conductivities at NDEP Specified Locations (Table given to Bob Broadbent by Brenda Pohlmann, NDEP).

US Bureau of Reclamation, March, 1984, Pittman Verification Program, Elevation of the Top of the Muddy Creek Formation.

US Geological Survey, Water Resources Data, Nevada, USGS, Carson City, Nevada, 1991 - 1996.

## Tables

**Table 1 Perchlorate Concentrations in Groundwater**

Well I.D.	Date Sampled	Results (mg/l)	Laboratory	Results (mg/l)	Laboratory
PL-635	1/15/98	22.4	A.P.	17.5	W.L.
PL-637	12/31/97	0.25	A.P.	ND	W.L.
PL-641	12/31/97	0.12	A.P.	ND	W.L.
PL-645	12/31/97	<.025	A.P.	ND	W.L.
PL-651	12/31/97	0.34	A.P.	0.22	W.L.
PL-653	12/31/97	1.07	A.P.	0.79	W.L.
HMW-1	1/2/98	3.77	A.P.	3.10	W.L.
HMW-2	1/2/98	3.52	A.P.	2.80	W.L.
HMW-15	1/2/98	<.003	A.P.	ND	W.L.
HMW-16	1/2/98	0.098	A.P.	0.02	W.L.
H-12	10/30/97	ND	A.P.	ND	W.L.
H-13	10/30/97	ND	A.P.	NS	W.L.
H-14	10/30/97	9.04	A.P.	NS	W.L.
H-15	10/30/97	ND	A.P.	NS	W.L.
H-16	10/30/97	28.70	A.P.	29.00	W.L.
H-20	10/30/97	0.003	A.P.	NS	W.L.
H-30	10/30/97	26.50	A.P.	NS	W.L.
H-32	10/30/97	2.20	A.P.	NS	W.L.
H-33	10/30/97	2.20	A.P.	NS	W.L.
H-39	10/30/97	0.04	A.P.	NS	W.L.
MW-A	9/15/97	NS	A.P.	42.00	W.L.
MW-A	12/4/97	71.00	A.P.	NS	W.L.
MW-B	9/11/97	NS	A.P.	8.00	W.L.
MW-B	12/4/97	14.00	A.P.	NS	W.L.
MW-C	9/15/97	NS	A.P.	230.00	W.L.
MW-C	12/4/97	224.00	A.P.	NS	W.L.
MW-D	9/15/97	NS	A.P.	600.00	W.L.
MW-D	12/5/97	507.00	A.P.	346.00	W.L.
MW-E	9/11/97	NS	A.P.	0.24	W.L.
MW-E	12/4/97	0.56	A.P.	NS	W.L.
MW-F	9/11/97	NS	A.P.	70.00	W.L.
MW-F	12/3/97	102.00	A.P.	NS	W.L.
MW-G	12/4/97	213.00	A.P.	196.00	W.L.
MW-H	12/5/97	0.14	A.P.	NS	W.L.
MW-I	12/3/97	0.02	A.P.	0.01	W.L.
MW-J	12/3/97	ND	A.P.	ND	W.L.
MW-J	1/5/98	<.003	Montgomery	ND	W.L.
MW-K	12/4/97	0.48	A.P.	NS	W.L.
MW-L	12/2/97	0.11	A.P.	0.091	W.L.
MW-N	1/2/98	0.57	A.P.	0.37	W.L.
MW-O	1/2/98	0.22	A.P.	0.09	W.L.
MW-P	1/2/98	0.8	A.P.	0.62	W.L.
MW-Q	1/2/98	1.34	A.P.	0.91	W.L.
MW-R	1/5/98	<.003	Montgomery	ND	W.L.
Thatcher	12/5/97	210	A.P.	NS	W.L.
LG-225	9/15/97	NS	A.P.	0.18	W.L.
LG-225	12/4/97	0.075	A.P.	NS	W.L.
LG-225A	9/15/97	NS	A.P.	0.092	W.L.
LG-027	1/2/98	<.003	A.P.	ND	W.L.
MW-7	1/15/97	0.68	A.P.	0.57	W.L.
MW-8	1/15/97	1.4	A.P.	1.2	W.L.
MW-9	1/15/97	2.87	A.P.	2.8	W.L.
MC-1	1/5/98	<.003	A.P.	ND	W.L.

A.P. = American Pacific Corporation Laboratories

W.L. = Weck Laboratories, Inc.

NS = Not sampled

ND = Not detected at method detection limits

**Table 1 Perchlorate Concentrations in Groundwater (Continued)**

Well I.D.	Date Sampled	Results (mg/l)	Laboratory	Results (mg/l)	Laboratory
MC-2	1/5/98	0.034	A.P.	ND	W.L.
MC-3	1/5/98	<.003	A.P.	0.05	W.L.
MC-4	1/5/98	0.131	A.P.	0.10	W.L.
M-10	8/24/97 - 8/30/97	53.00	Kerr-McGee*	52.50	LAS**
M-11	8/24/97 - 8/30/97	260.00	Kerr-McGee*	NS	LAS**
M-12A	8/24/97 - 8/30/97	3,400.00	Kerr-McGee*	3,700.00	LAS**
M-13	8/24/97 - 8/30/97	81.00	Kerr-McGee*	NS	LAS**
M-29	8/24/97 - 8/30/97	<0.70	Kerr-McGee*	NS	LAS**
M-32	8/24/97 - 8/30/97	870.00	Kerr-McGee*	NS	LAS**
M-50	8/24/97 - 8/30/97	1,600.00	Kerr-McGee*	NS	LAS**
M-21	8/24/97 - 8/30/97	52.00	Kerr-McGee*	NS	LAS**
M-35	8/24/97 - 8/30/97	340.00	Kerr-McGee*	NS	LAS**
M-34	8/24/97 - 8/30/97	1,100.00	Kerr-McGee*	NS	LAS**
M-2A	8/24/97 - 8/30/97	650.00	Kerr-McGee*	NS	LAS**
M-76	8/24/97 - 8/30/97	200.00	Kerr-McGee*	NS	LAS**
M-39	8/24/97 - 8/30/97	110.00	Kerr-McGee*	113.00	LAS**
M-89	8/24/97 - 8/30/97	1,200.00	Kerr-McGee*	NS	LAS**
M-37	8/24/97 - 8/30/97	18,000.00	Kerr-McGee*	NS	LAS**
M-17	8/24/97 - 8/30/97	880.00	Kerr-McGee*	NS	LAS**
M-14	8/24/97 - 8/30/97	28.00	Kerr-McGee*	NS	LAS**
M-22	8/24/97 - 8/30/97	2,800.00	Kerr-McGee*	NS	LAS**
M-36	8/24/97 - 8/30/97	2,900.00	Kerr-McGee*	NS	LAS**
M-25	8/24/97 - 8/30/97	780.00	Kerr-McGee*	NS	LAS**
M-62	8/24/97 - 8/30/97	25.00	Kerr-McGee*	NS	LAS**
M-57	8/24/97 - 8/30/97	22.00	Kerr-McGee*	NS	LAS**
M-88	8/24/97 - 8/30/97	23.00	Kerr-McGee*	NS	LAS**
M-86	8/24/97 - 8/30/97	1,800.00	Kerr-McGee*	NS	LAS**
M-83	8/24/97 - 8/30/97	1,400.00	Kerr-McGee*	1,610.00	LAS**
M-90	8/24/97 - 8/30/97	1,700.00	Kerr-McGee*	NS	LAS**
M-48	8/24/97 - 8/30/97	630.00	Kerr-McGee*	NS	LAS**
M-23	8/24/97 - 8/30/97	1,600.00	Kerr-McGee*	NS	LAS**
M-5A	8/24/97 - 8/30/97	<0.70	Kerr-McGee*	NS	LAS**
M-6A	8/24/97 - 8/30/97	<0.70	Kerr-McGee*	0.56	LAS**
M-7A	8/24/97 - 8/30/97	47.00	Kerr-McGee*	NS	LAS**
M-44	8/24/97 - 8/30/97	1,400.00	Kerr-McGee*	1,550.00	LAS**
M-96	8/24/97 - 8/30/97	1,500.00	Kerr-McGee*	NS	LAS**
1-A	8/24/97 - 8/30/97	530.00	Kerr-McGee*	542.00	LAS**
1-B	8/24/97 - 8/30/97	1,400.00	Kerr-McGee*	NS	LAS**
1-D	8/24/97 - 8/30/97	1,200.00	Kerr-McGee*	NS	LAS**
1-E	8/24/97 - 8/30/97	1,100.00	Kerr-McGee*	NS	LAS**
1-F	8/24/97 - 8/30/97	2,000.00	Kerr-McGee*	NS	LAS**
1-G	8/24/97 - 8/30/97	2,300.00	Kerr-McGee*	NS	LAS**
1-H	8/24/97 - 8/30/97	2,800.00	Kerr-McGee*	3,100.00	LAS**
1-I	8/24/97 - 8/30/97	660.00	Kerr-McGee*	NS	LAS**
1-J	8/24/97 - 8/30/97	49.00	Kerr-McGee*	NS	LAS**
1-K	8/24/97 - 8/30/97	19.00	Kerr-McGee*	NS	LAS**
1-L	8/24/97 - 8/30/97	1,500.00	Kerr-McGee*	NS	LAS**
1-M	8/24/97 - 8/30/97	1,000.00	Kerr-McGee*	NS	LAS**
1-N	8/24/97 - 8/30/97	1,600.00	Kerr-McGee*	NS	LAS**
1-O	8/24/97 - 8/30/97	2,300.00	Kerr-McGee*	2,560.00	LAS**

\* As reported by Kerr-McGee Chemical Corp. in the report dated Oct. 1, 1997 entitled Groundwater Investigation for Perchlorate Impact at Kerr-McGee Chemical Corp. Henderson, Nevada

\*\* Sampled by the Nevada Division of Environmental Protection

LAS = Las Laboratories, Inc.

A.P. = American Pacific Corporation Laboratories

W.L. = Weck Laboratories, Inc.

NS = Not sampled

ND = Not detected at method detection limits

**Table 2 Groundwater Elevation Data**

Well I.D.	Date	Well Head Elevation ft.	Depth to Water (ft.)	Water Elevation (ft.)
PL-635	1/15/97	1,621.33	14.27	1,607.06
PL-637	1/2/98	1,621.92	10.32	1,611.60
PL-641	1/2/98	1,623.06	7.94	1,615.12
PL-645	1/2/98	1,625.55	8.86	1,616.69
PL-651	1/2/98	1,629.55	10.30	1,619.25
PL-653	1/2/98	1,631.14	11.28	1,619.86
HMW-1	1/2/98	1,601.49	11.71	1,589.78
HMW-2	1/2/98	1,602.23	9.37	1,592.86
HMW-3	1/2/98	1,601.54	NM - Dry	NM - Dry
HMW-15	1/2/98	1,611.82	10.28	1,601.54
HMW-16	1/2/98	1,621.78	11.35	1,610.43
H-12	10/30/97	1,710.00	23.66	1,686.34
H-13	10/30/97	1,819.47	47.44	1,772.03
H-14	10/30/97	1,711.94	24.09	1,687.85
H-15	10/30/97	1,772.20	46.31	1,725.89
H-16	10/30/97	1,713.88	21.51	1,692.37
H-20	10/30/97	1,732.17	40.34	1,691.83
H-30	10/30/97	1,740.42	34.52	1,705.90
H-32	10/30/97	1,736.48	34.54	1,701.94
H-33	10/30/97	1,733.91	36.39	1,697.52
H-39	10/30/97	1,770.32	44.46	1,725.86
A	1/2/98 - 1/9/98	1,890.70	73.69	1,817.01
B	1/2/98 - 1/9/98	1,873.04	57.92	1,815.12
C	1/2/98 - 1/9/98	1,851.92	39.85	1,812.07
D	1/2/98 - 1/9/98	1,838.99	31	1,807.99
E	1/2/98 - 1/9/98	1,894.70	74.85	1,819.85
F	1/2/98 - 1/9/98	1,783.71	34.36	1,749.35
G	1/2/98 - 1/9/98	1,904.99	94.54	1,810.45
H	1/2/98 - 1/9/98	1,974.58	152.84	1,821.74
I	1/2/98 - 1/9/98	1,859.22	46.99	1,812.23
J	1/2/98 - 1/9/98	1,669.77	21.55	1,648.22
K	1/2/98 - 1/9/98	1,668.03	26.52	1,641.51
L	1/2/98 - 1/9/98	1,884.07	61.98	1,822.09
N	1/2/98 - 1/9/98	1,643.84	27.57	1,616.27
O	1/2/98 - 1/9/98	1,643.84	26.98	1,616.86
P	1/2/98 - 1/9/98	1,640.87	27.18	1,613.69
Q	1/2/98 - 1/9/98	1,633.46	13.98	1,619.48

NM = Not Measured

**Table 3 Surface Water Perchlorate Concentrations**

Sample Location	Date	Results (mg/l)	Laboratory
North Lakeshore Drive (Avg.)	8/10/97 - 12/19/97	0.848	LAS
Poleline Road (Avg.)	8/10/97 - 11/1/97	0.6	LAS
Pitman Bypass Outfall (Avg.)	8/10/97 - 11/1/97	0.058	LAS
Upstream Las Vegas Wash	8/10-18/97	0.011	LAS
Between Las Vegas & County Sewage Plant	8/10-18/97	0.047	LAS
Outside County Sewage	8/10-18/97	0.014	LAS
Henderson Sewage Treatment Plant Outfall	8/10-18/97	0.01	LAS
Duck Creek	8/10-18/97	0.014	LAS
Pond 1 Near Las Vegas Wash	1/15/98	0.83	A.P.
Pond 2 Near Las Vegas Wash	1/15/98	2.2	A.P.
Pond 3 Near Las Vegas Wash	1/15/98	2.1	A.P.
Spring Near Las Vegas Wash	1/15/98	2.1	A.P.
Culvert South Bank	1/15/98	0.68	A.P.
Culvert Center	1/15/98	0.55	A.P.
Culvert North	1/15/98	0.5	A.P.
Las Vegas Wash - Middle	1/15/98	0.008	A.P.
Las Vegas Wash - Upstream	1/15/98	0.041	A.P.
Las Vegas Wash - Downstream	1/15/98	0.014	A.P.

LAS = Las Laboratories, Inc.

A.P. = American Pacific Corporation Laboratories